

## MAJOR ISSUES AND FINDINGS

### Biological Indicators of Water Quality

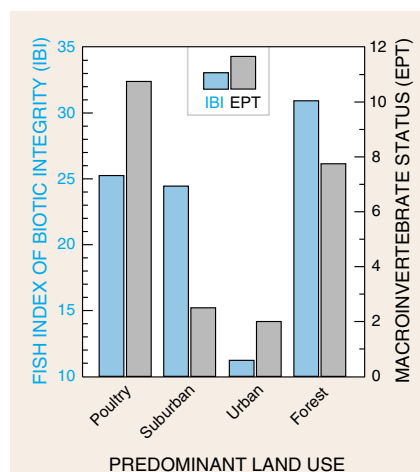
In the Piedmont Province, poultry production, suburban and urban land uses, and silviculture are human activities that influence the water quality of tributaries to the Chattahoochee and Flint Rivers. The biological condition of these tributaries are influenced by water-quality and hydrologic conditions that vary, depending on the type and intensity of human activities. Forested watersheds in the ACF River Basin are subject to less human activities than the other land uses studied, and although not pristine, the biological condition in streams draining forested watersheds may be the best attainable in the ACF River Basin.

Tributaries of the Chattahoochee River in the Piedmont are inhabited by 42 native and 8 non-native (introduced) fish species (Couch and others, 1995). Because fish distribute themselves in streams relative to the location of their preferred habitats, not all 50 species live in any one stream reach. In streams with forested watersheds, about 20 fish species may live in a typical stream reach. In comparison

Aquatic biological communities commonly are sensitive indicators of stream-water quality. In highly populated areas, evaluations of aquatic biological communities commonly are the only assessment approach that can account for (1) highly transient water-quality problems stemming from urban runoff, accidental spills, or periodic sewer overflows, and (2) the cumulative effects of a potentially wide range of chemical contaminants.

The biological condition of streams is evaluated within water-quality assessment programs by comparing the type, number, or abundance of species that comprise aquatic biological communities to that of streams known to be pristine or to be least influenced by human activities. In this study, the biological condition of streams was measured using fish and benthic macroinvertebrate (adult and larval insects, crustaceans) communities in stream reaches representing predominant land uses in the watershed.

Two separate indices were used. The first index, an **Index of Biotic Integrity (IBI)**, is based on fish community data. IBI scores for a given stream were derived by summing scores of several separate factors that describe fish communities (DeVivo and others, 1997). Examples of such factors are the number of insect-eating and omnivorous (generalized-feeding) fish, the number of native sucker and minnow species, and the number of non-native species. The second index, an **EPT Index**, is based on the abundance of selected orders of pollution-sensitive insect larvae. It is the sum of the number of families within the insect orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in a stream reach. Streams with higher IBI and EPT index scores are indicative of better biological conditions than streams with lower scores.



In the Piedmont Physiographic Province of ACF River Basin, stream biological communities are most degraded in areas of suburban and urban land use. Fish communities show the most degradation in streams draining areas of urban land use, whereas macroinvertebrate communities are degraded in streams draining areas of suburban and urban land use.

to streams draining watersheds with predominantly poultry, suburban, or urban land use, streams with forested land use had the best biological condition as shown by the Index of Biotic Integrity (IBI, described above).

Although streams in predominantly forested watersheds are periodically disturbed by timber harvesting, these watersheds do not have high yields of nutrients or sediments (page 15) that influence biological conditions by altering stream habitats or food resources and do not contain the wide range of chemical and microbial contaminants present in streams draining predominantly suburban and urban watersheds (page 10). IBI scores indicate a similar level of degraded biological conditions for streams draining watersheds with predominantly poultry and suburban land use. Streams draining watersheds with predominantly urban land use had severely degraded biological conditions.

The macroinvertebrate status of streams draining watersheds with predominantly forested and poultry land use were relatively high as measured by the EPT Index (described above) scores, indicating markedly better biological conditions in these streams than in streams draining watersheds with predominantly suburban or urban land use. Poor habitat, high stormflows, and the presence of chemical contaminants, such as insecticides, may contribute to the loss of pollution-intolerant insect species in the streams draining watersheds with predominantly suburban and urban land use. The higher EPT Index scores in streams draining watersheds with predominantly poultry land use may be related to high nutrient inputs that increase the availability or variety of food resources beyond what is present in streams draining watersheds with predominantly forested land use.

As the human population of Metropolitan Atlanta continues to increase, forest and pasture land is being developed for suburban or urban use. Fish IBI scores for 21 tributaries of the Chattahoochee River that varied in the extent of urban development as measured by human population density show an immediate decline in biological condition with the onset of suburban and urban development (DeVivo and others, 1997).

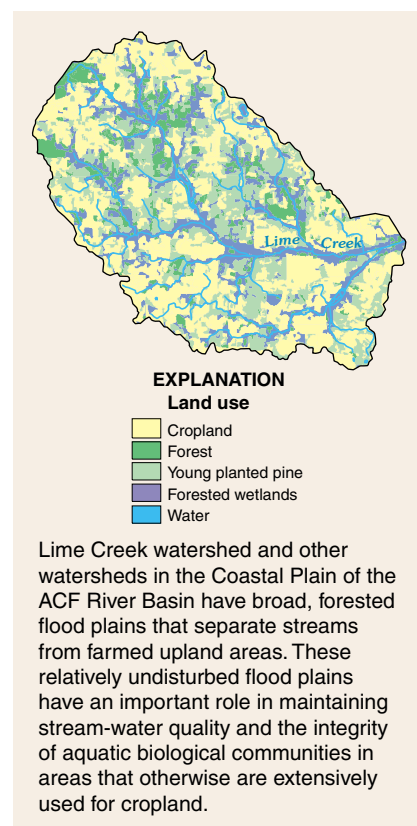
Watersheds with higher population densities generally had lower fish IBI scores, indicating poorer biological condition. Streams in areas of predominantly suburban or urban land use generally had less than one-half the number of fish species present in streams in areas of predominantly forested land use, and as many as 90 percent of the fish in urban streams were introduced. Species that survive outside of their native streams often thrive where water quality or habitat is degraded. Native minnow and sucker species were all but absent in urban streams. Minnows are important in the aquatic food chain as prey for larger

fish, aquatic snakes, turtles, and wading birds. Although suckers are not popular game fish, they are ecologically important because they often account for the largest fish biomass in healthy Piedmont streams. Streams draining urban lands in Metropolitan Atlanta contain elevated concentrations of nutrients (page 14) and a variety of chemical contaminants such as pesticides and trace elements (pages 10–11 and 19). Periodic discharges from combined sewers or broken or clogged sanitary sewers carry additional chemical and microbial contaminants into nearby streams. However, most nutrients and chemical contaminants enter streams as storm runoff from impervious surfaces (streets, parking lots) or as groundwater discharge that has percolated through landscaped areas. The degraded biological condition of urban streams results from the cumulative effects of high stormflows and exposure to a variety of contaminants.

The Coastal Plain of the ACF River Basin is composed of cropland and silvicultural land in upland areas and extensive and continuous forested wetlands in river bottoms. Relatively undisturbed riparian flood-plain and wetland habitats are present throughout this area. This contrasts to many other intensively farmed areas of the Nation where wetlands have been drained, channelized, or filled, and little or no riparian buffers remain between cropland and streams.

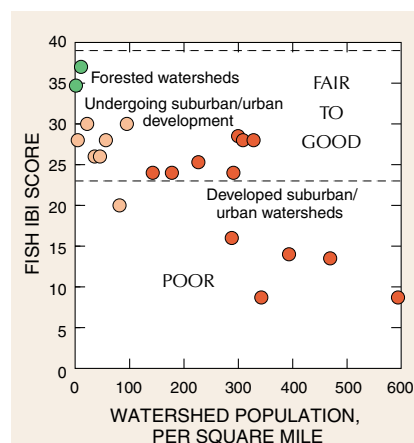
Flood-plain wetlands provide many ecological benefits such as dissipating the energy of floods, reducing erosion, and stabilizing the streamside environment. Winter and spring flooding is a normal occurrence in Coastal Plain streams, and many fish species use the flood plains as spawning, nursery, and foraging areas.

In July 1994, flooding from Tropical Storm Alberto resulted in streamflows that exceeded the 100-year recurrence interval throughout the Flint River



Basin (page 9). The flood occurred outside of the normal period of seasonal flooding. The ACF River Basin NAWQA investigated the influence of this flood on the fish community of Lime Creek, a stream located in the area that received a large amount of rainfall from Tropical Storm Alberto. The fish-community surveys were performed before the flood and for a 2-year period after the flood.

Thirty-two fish species were identified during the sampling period. Although an IBI has not been developed for Coastal Plain fish communities, the number and diversity of fish species in Lime Creek indicate a healthy fish community. The flood did not result in a catastrophic loss of fish species. All but one fish species present in Lime Creek before the flood were also present after the flood. The potential disturbance to the fish community was lessened by the forested flood-plain wetlands that remain intact in a watershed that is otherwise predominantly cropland.



In the Piedmont, fish communities are degraded by increasing urban development. In forested watersheds, streams have fish communities that are represented by a diversity of mostly native species with varied tolerance to pollution. As watersheds are developed, fish communities in streams are dominated by pollution-tolerant, mostly non-native species.